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I. INTRODUCTION

In response to long-term improvements in Soviet strategic forces, the United States has undertaken a modest but significant program of modernization of its strategic forces. Elements of the program will improve the ability of the American strategic arsenal to withstand a Soviet counter-force first-strike; for example, the multiple-shelter basing mode for the MX will increase dramatically the number of hardened targets the Soviets would need to attack in a first-strike, making such an attack much less attractive. Other elements of the program will augment the second-strike capability of American nuclear forces against the Soviet strategic arsenal; specific actions in this area include the MX itself, accuracy improvements in the Trident II missile, and a new cruise missile carrier which will be more capable than the B-52G bomber.

However, the strategic balance will not be fully affected by the modernization program until the late 1980s. Until then, there is a concern that the Soviet Union will improve its forces to the extent that it will temporarily achieve strategic superiority over the United States. Hence an interval may develop between the present and the late 1980s which will be characterized by a strategic imbalance in favor of the Soviet Union, and as a result of this imbalance, an enfeebled United States. The argument is that the United States, fearful of the asymmetric risks of a strategic exchange, would be unwilling to take actions necessary to confront and to contain an expansionistic Soviet Union.

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As a corollary, the Soviet Union, mindful that its strategic advantage was only temporary, might be all the more aggressive during this period in which it would in fact have the advantage at the nuclear level.[1]

Part of this period is of course covered by the proposed SALT II accord. Indeed, it is argued that the treaty is inadequate as it fails to arrest (and in more extreme versions of the argument it is said to augment) the feared improvement in the Soviet strategic position; hence the treaty should be rejected. In evaluating the treaty, then, the central military question is this: will the Soviet Union develop meaningful strategic superiority during the time period conditioned by SALT II? An affirmative answer to this question might lead to the conclusion that the 1980s will be a "period of maximum peril" for the United States and its allies. To forestall this problem, the United States would need to accelerate its modernization program dramatically; in addition, it perhaps should end once and for all what might be an illusion that the United States and the Soviet Union share a consensus on the desirability of effective arms control--and what better way to shatter this "illusion" than by rejecting its symbol, SALT II? On the other hand, if it is determined that SALT II would not produce strategic balance tilted in favor of the Soviet Union, and might indeed contribute to strategic stability, the treaty, in conjunction with the modernization program currently planned, should be accepted by the United States.

Of course, if the central question is whether SALT II will allow the Soviets to achieve temporary strategic superiority, then the next question that must be addressed is as follows: what is the concrete meaning of strategic superiority? One presentation of the problem is that, during the 1980s under SALT II, Soviet strategic forces would be so improved that, using only a small portion of its arsenal, the Soviet Union theoretically could destroy the bulk of the American strategic arsenal. American forces might be so degraded that an effective

counter-strike could not be executed against the massive quantities of residual Soviet systems. Moreover, the United States could not credibly threaten to retaliate by attacking Soviet cities and industry, for this would provoke a tremendous blow by the Soviet Union against equivalent American targets. In sum, the United States would have no effective response to a Soviet attack or threat of an attack. The United States would be check-mated at the strategic level, allowing the Soviet Union to exploit its superiority at the conventional level, and to extract political gains through nuclear blackmail.[2]

These are the conditions of strategic superiority. From them emerge requirements of strategic policy which must be satisfied in order to obviate the possibility of Soviet strategic superiority; these requirements are extensions of the pre-exchange concepts of assured destruction and essential equivalence to post-counterforce strategic environments.[3]

The first requirement is that the United States must be able to sustain a massive Soviet first-strike against American strategic forces, and then have the capability <u>both</u> to launch a retaliatory strike against Soviet nuclear forces <u>and still have</u> forces sufficient to deter further Soviet attacks, which would probably be against American cities, industries, and other non-hardened targets. In other words, after responding to a Soviet counterforce first-strike by launching a retaliatory blow against Soviet nuclear forces not used in the first-strike, the United States must still retain strategic nuclear forces of such magnitude that, should they be used against Soviet cities and industry in response to an escalation by the Soviets to attacks on this category of American targets, they would inflict some absolute level of damage unacceptable to the Soviet leadership. Because the damage would be unacceptable, and because the Soviet leadership would know that it would be inflicted in response to a Soviet attack on American cities and industries, the Soviets would be unlikely to escalate the conflict. Indeed,

because the Soviet leadership would know that a counterforce attack would not lead to a strategic environment in which they could credibly sustain American retaliatory attacks at the counterforce and countervalue levels, they would have little rational incentive to launch an attack--threats to do so would lack credibility and therefore would not be politically effective.

The second requirement is that the relative strategic power of the Soviet Union must not increase so greatly if it initiates a counterforce exchange that Soviet leaders might be inclined to authorize or to threaten to authorize an attack. This requirement goes beyond the first, because it means that the United States must not only have the forces capable of inflicting some absolute level of damage on Soviet cities and industry after a counterforce exchange initiated by the Soviet Union, but in addition the United States must have residual forces that maintain the pre-exchange relative balance between the two arsenals. Fulfillment of this requirement would persuade the Soviets that, even if they launch a first-strike, they will not improve their relative strategic position--this means, if the United States is also able to inflict unacceptable damage on the Soviet Union at the countervalue level, that the Soviets have nothing to gain through initiation or threat of initiation of a strategic exchange. Hence it would be unlikely that the Soviets would pursue the nuclear option.

To summarize, one concern about SALT II is that it will make available opportunities to the Soviet Union to attain and exploit strategic nuclear superiority during the 1980s. To be certain that SALT would not allow such a situation to evolve, during the period of the treaty the United States must be able to engage in a counterforce exchange initiated by the Soviet Union, have residual forces capable of inflicting unacceptable damage on the Soviet Union if the conflict should escalate, and the residual forces must be of sufficient magnitude that there is no dramatic change in the relative strategic balance. In these

circumstances, American deterrence would be of high quality in a strategic environment conditioned by SALT II, and there would be few opportunities for Soviet adventurism resulting from some perceived strategic imbalance in their favor.

The challenge, then, is to assess realistically the strategic balance under SALT II; the discussion below attempts to meet this challenge. First, the relevant provisions of SALT II are highlighted, and an estimate is made of Soviet and American forces that can be deployed over the life of the treaty. Then an analysis is made of Soviet-American nuclear exchanges, and on the basis of various measures of strategic effectiveness derived from the concern about the two requirements of successful American strategic policy, an assessment is made of the forces of each side after counterforce exchanges. The essay concludes with a discussion of the policy recommendations emerging from the analysis.

Before we enter the main body of the essay, a brief note of caution must be introduced. A discussion of this nature, which involves the estimation of <u>future</u> forces, the construction of a model of <u>theoretical</u> exchanges, and an analysis of <u>possible</u> residual forces and their <u>likely</u> effectiveness, obviously involves the making of several assumptions about a subject marked by great uncertainty. The quality of the discussion clearly depends upon the plausibility and integrity of these assumptions, for they will fundamentally affect the results of the analysis. As will emerge from the essay, an effort has been made to employ plausible assumptions, avoiding the extremes of undue optimism and pessimism about the effectiveness of American forces. However, if there is a bias, it probably is to understate slightly the capabilities of the American arsenal, and to overstate Soviet capabilities; this slight bias is perhaps necessary if only to be prudent. Finally, it must be emphasized that while an effort has been made to employ realistic assumptions about the future of the Soviet-American strategic balance,

if it is determined that some of these assumptions become in need of alteration, then it may be necessary as well to reevaluate the findings of the analysis.

II. THE AGREEMENT AND POSSIBLE STRATEGIC FORCES

SALT II is comprised of a Treaty, a Protocol, and a Joint Statement of Principles.[4] The Protocol bans through 1981 the deployment of long-range cruise missiles on sea or on land-based platforms, and the deployment of ground and air-mobile long range ballistic missiles. The Joint Statement of Principles allows each side an opportunity to express for the record its priorities in future negotiations on strategic weapons.

The Treaty, binding through 1985, will have the greatest impact of the three components of SALT II on the near-term strategic arsenals of the two sides. By 1982 both may have no more than 2,250 strategic nuclear delivery vehicles: Intercontinental Ballistic Missile (ICBM) launchers, Submarine Launched Ballistic Missile (SLBM) tubes, Heavy Bombers, and any aircraft equipped with long-range (i.e., over 600 kilometers) cruise missiles. Within this overall ceiling there are three sublimits. First, both sides are limited to a total of 1,320 aircraft equipped with long-range cruise missiles, and ballistic missiles equipped with Multiple Independently Targetable Reentry Vehicles (MIRVs). Second, of the 1,320, no more than 1,200 may be MIRVed ballistic missiles. Finally, of the 1,200, no more than 820 may be land-based. Within this limit of 820, the Soviets may deploy no more than 308 "heavy" MIRVed ICBMs--the SS-18 or its follow-on which may be no larger than the SS-18.

Characteristics of strategic systems are also affected by the Treaty. Any test of an ICBM or SLBM with MIRVs renders all missiles of that type classified and counted as a MIRVed system, even if some of the missiles of that type have only one warhead-carrying reentry vehicle (RV) when actually deployed. If an

ICBM is tested with more RVs than previously observed on that missile, then all of that size will be classified as a "new type" missile of which each side may have only one during the life of the Treaty. Because the Soviets have indicated that their "new type" missile is a single-RV replacement for the SS-11, the effect is to limit the numbers of RVs on Soviet ICBMs to those levels already tested on each of the systems: for the SS-18, 10 RVs; for the SS-19, 6 RVs; and for the SS-17, 4 RVs.[5] (The limit would also apply to a follow-on to any of these systems.) These provisions limit the U.S. to 7 RVs on Minuteman IIIs; however, the U.S. probably will limit itself to 3 RVs per booster.

In addition, neither side may deploy more RVs on new ICBMs or SLBMs than have been already tested on these two categories of missiles by either the U.S. or the U.S.S.R. Hence the "new type" American ICBM may have no more than 10 RVs (the number tested on a Soviet SS-18), and new Soviet SLBMs may have no more than 14 RVs (which were tested on an American C-3). American aircraft to be counted against the SALT II limits are B-52s, 3 B-1 Prototypes, and any new Cruise Missile Carrier (CMC) which the U.S. might deploy. Soviet aircraft limited under SALT II are Bears and Bisons, or any follow-on to either, or any aircraft equipped with long-range cruise missiles--including the Backfire if it is so equipped in the future.[6] Finally, Cruise Missile Carriers may be armed with no more than an average of 28 cruise missiles.

These SALT II limits, when correlated with information publicly available on current and prospective Soviet and American strategic programs, make possible the rough estimation of future nuclear forces deployed by each side. Possible Soviet and American strategic arsenals, presented in Tables 1 and 2 respectively, are estimated for 1985, the last year of the Treaty and the year which reveals the full impact of the Treaty on deployment levels. If the Soviets decide to build close to the MIRVed ICBM limit, they might deploy 308 SS-18s and a combined

total of 500 SS-19s and SS-17s. They could then equip all of their estimated 17 Delta II and Delta III SSBNs with SS-NX-18 MIRVed SLBMs, and still under SALT II be able to deploy 5 very new Typhoon SSBNs, each with 24 Typhoon MIRVed SLBMs. These forces would take the Soviets to the 1,200 MIRVed ballistic missile limit. On unMIRVed missiles, the Soviets could deploy SS-NX-17 SLBMs (which have three RVs that cannot be targeted independently) in all of their 34 Yankee class SSBNs and estimated 12 Delta I SSBNs, yielding a total of 688 unMIRVed SLBMs. If the Soviets continue to have no fewer than 140 SALT-accountable bombers, they would then be constrained to 222 unMIRVed ICBMs, probably a follow-on to the SS-11 (1,200 + 688 + 140 + 222 = 2,250, the SALT II limit).[7] Adding 250 Backfires (which do not come under SALT II limits but which may have a strategic role), the Soviets might have a total of 2,500 strategic nuclear delivery vehicles by 1985.

An important feature of the American force estimate is the exclusion of the MX missile from the U.S. arsenal in either a fixed or partially mobile basing mode; this reflects the judgement that the development and testing phases of the MX program will take initial deployment (if the U.S. decides to do so) beyond 1985.[8] In order to equip 120 B-52s with cruise missiles, and to pursue the Trident SSBN program within the SALT II limits, the U.S. might need to retire one Poseidon SSBN three years ahead of schedule, to destroy about 50 Minuteman III silos, and to deploy 9 rather than the currently planned 10 Tridents by 1985.[9] Given Treaty constraints, the U.S. arsenal in 1985 might include 500 Minuteman III MIRVed ICBMs, 288 C-3 MIRVed SLBMs in 18 Poseidon SSBNs, 408 C-4 (Trident I) MIRVed SLBMs in 12 Poseidon and 9 Trident SSBNs, and 120 B-52 Cruise Missile Carriers, yielding a total force of 1,316 MIRVed missiles and Cruise Missile Carriers (the limit, again, is 1,320).[10] Some 341 B-52s will be SALT-accountable, even though 80 of these are conventionally equipped B-52Ds. With 120 B-52Gs deployed as

Table 1. Estimated Soviet Strategic Forces: 1985

Launcher	Number[a]	RVs/Launcher[b]	Yield/RV[c] (Megatons)	Accuracy[d] (nm CEP)	Total RVs	EMT/RV[e]	Total EMT
ICBMs							
SS-18	308	10	.75	.1	3080	.825	2541.0
SS-19	365	6	.8	.1	2190	.86	1883.4
SS-17	135	4	.6	.1	540	.71	383.4
SS-11 Follow-On	222	1	20.0	NA	222	7.37	1636.1
SLBMs							
SS-NX-17 (in 34 Ys and 12 DIs)	688	3 (MRV)	.2	.5	2064	.341	703.8
SS-NX-18 (in 17 DIIs and DIIIs)	272	3	.2	.5	816	.341	278.3
Typhoon (in 5 Typhoons)	120	14	.1	.25	1680	.215	361.2
Bombers							
Bear	100	1	20.0	NA	100	7.37	737.0
Bison	40	1	5.0	NA	40	2.92	116.8
Backfire	250	2	.2	NA	500	.341	170.5
SALT-Accountable Total	2250				10732		8641.0
Total Strategic Force	2500				11232		8811.5

Table 1 (continued): Sources

a. ICBM figures are explained in the text. The figure for Yankee SSBNs is from Senate DOD Hearings, FY 1979, Pt. 1, p. 526. The total of 29 Delta class SSBNs is from DOD FY 1980 Report, p. 72. In January 1976, the Soviets were reported to have 11 Delta I SSBNs (Senate DOD Hearings, FY 1977, Pt. 1, p. 399); the following year the production of both Delta I and Delta II SSBNs were reported (Senate DOD Hearings, FY 1978, Pt. 1, p. 382); and in February 1978 it was reported that production of Delta I SSBNs had ceased (Senate DOD Hearings, FY 1979, Pt. 1, p. 426). Hence it is estimated that the Soviets deployed 12 Delta I's and 17 Delta II's and III's. This would permit them to deploy 5 new Typhoon SSBNs, and to deploy MIRVed ICBMs close to the SALT II limit.

b. On the SS-18, Peter Hughes, "SALT II and the Emerging Strategic Threat," Air Force Magazine, (March 1979), p. 49; for the MIRVed ICBMs, the SS-NX-17 and SS-NX-18, and the bombers, see U.S. Congress, Congressional Budget Office, Background Paper; Counterforce Issues for the U.S. Strategic Nuclear Forces, (January 1978), p. 16. The Typhoon characteristics are explained in the text.

c. Yield for the SS-18 is from Hughes, p. 49; for the SS-11 FO, see Paul H. Nitze, "Considerations Bearing on the Merits of an Agreement," (Washington: 6 March 1979), p. 5; for the Typhoon, see text; for all others, see CBO Background Paper, p. 16.

d. Accuracy is expressed as circular error probable (CEP): the probability that one-half the warheads aimed at a particular point will land within the area of a circle whose radius is the stated CEP figure. For MIRVed ICBMs, see Hughes, p. 16; for SLBMs, CBO Background Paper, p. 16.

e. EMT is nominal yield to the two-thirds power.

Table 2. Estimated American Strategic Forces: 1985

Launcher	Number[a]	RVs/Launcher[b]	Yield/RV[c]	Accuracy[c]	Total RVs	EMT/RV[d]	Total EMT
ICBMs							
Titan II	54	1	9.0	.5	54	4.33	233.8
Minuteman II	450	1	1.0	.3	450	1.0	450.0
Minuteman III							
(with MK 12 RVs)	200	3	.17	.11	600	.307	184.2
(with MK 12A RVs)	300	3	.35	.1	900	.497	447.2
SLBMs							
C-3 (in 18 Poseidons)	288	14	.04	.25	4032	.117	471.8
C-4 (in 12 Poseidons)	192	8	.1	.25	1536	.215	330.2
C-4 (in 9 Tridents)	216	8	.1	.25	1728	.215	371.5

Bombers	UE	All						
B-52G CMC	120	120	20	.2	.05	2400	.341	818.4
B-52G Penetrator	31	45	8 SRAM, 4 Bomb	.2, 1.0	.05(Bomb)			
B-52H Penetrator	60	64	8 SRAM, 4 Bomb	", "	"	1388 SRAM	.341	473.3
B-52H Reserve	30	32	14 SRAM, 4 Bomb	", "	"	604 Bomb	1.0	604.0
FB-111	60	66	4 SRAM, 2 Bomb	", "	"			
B-52D	75	80	Conventionally equipped					
SALT-Accountable Total (including 80 B-52Ds)		2041				13296		4162.4
Total Strategic Force (excluding 80 B-52Ds)		2027				13692		4384.4

Table 2 (continued): Sources

a. The U.S. is assumed to maintain its current force of single-RV ICBMs; for these, and for the mix of MK12 and MK12A warheads of MMIIIs, see DOD FY 1980 Report, p. 66. On SLBMs, see footnotes 9 and 10; on bombers, see Senate DOD Hearings, FY 1979, Pt. 9, p. 6816.

b. The estimates for bomber warhead loadings are based on appropriation requests for SRAM internal rotary launchers and external pylons; see Senate DOD Hearings, FY 1979, Pt. 9, p. 6822. The number of bombs was revealed during these hearings. On the number of SRAMs per pylon (the number per internal launcher was noted in the hearings listed above), see Air Force Magazine, (May 1977), p. 126.

c. Yields and accuracies are from CBO Background Paper, p. 19.

d. EMT is nominal yield to the two-thirds power.

stand-off platforms for cruise missiles, about 141 B-52Gs and B-52Hs actually would be available as penetrator bombers. Adding 54 Titan II and 450 Minuteman II unMIRVed ICBMs, the total U.S. SALT-accountable force would be about 2,041 delivery vehicles. When 66 FB-111As equipped for strategic missions are included, and 80 B-52Gs excluded, then the U.S. might have a total of 2,027 strategic nuclear delivery vehicles by 1985.

In looking at the estimated characteristics of the two arsenals, note that those of the U.S.S.R. are especially difficult to determine; this is due to the extreme sensitivity of U.S. efforts to learn of these characteristics (the Soviet lack of forthrightness need only be mentioned). Hence fairly conservative figures have been chosen; for example, the estimate of 0.1 nautical mile accuracy for the Soviet MIRVed ICBMs, and the assumption of a 20 megaton RV for the SS-11

follow-on, are the most favorable from the Soviet viewpoint that could be found in open literature. In addition, estimates of the number (14) and yield (100 kilotons) for the Typhoon SLBM are based on the SALT RV limit for SLBMs, and the presumption that the Soviets want their RVs to be larger than those on comparable U.S. systems (i.e., the 40 kiloton RV on the C-3). On the other hand a new Soviet strategic bomber may be deployed soon, and its weapons capabilities may exceed those of the Bear and the Bison.

In contrast to the uncertainty about Soviet force characteristics, there is substantial public knowledge about the capabilities of American strategic forces. The estimate for C-3 SLBMs is somewhat optimistic, from the American viewpoint, for the assumed level of 14 RVs is greater than that sometimes reported by private sources.[11] The rationale for the larger number is that, first, it is the figure usually given by official U.S. sources, and second, as patrol areas of American SSBNs increase with the introduction of Trident SSBNs and the retrofitting of C-4 SLBMs into some Poseidon SSBNs, remaining Poseidons with C-3s will be able to move closer to their targets and therefore trade-off somewhat less range for more RVs per booster. In contrast to the optimism on the C-3, U.S. bomber capabilities may be underestimated in this analysis (comparable information on Soviet bombers is unavailable). For example, rather than the total number of SALT-accountable bombers, the strategic exchanges discussed below employ only those U.S. bombers which are unquestionably equipped for strategic missions (thus excluding the B-52Ds), and which are in combat-ready units (these bombers are referred to as "Unit Equipment" by the U.S. Air Force), and are not undergoing repair or modernization. Sustained tensions between the U.S. and the U.S.S.R. might cause these bombers to be introduced into the strategic arsenal. Also, estimates of warhead loadings are based on how the Air Force might actually equip its bombers (this is accomplished by evaluating Air Force budgetary requests); these loadings are

less than the potential weapons-carrying capabilities of the bombers (the exception to this is the B-52 CMC; budgetary analysis suggests it will carry the maximum number of cruise missiles possible).

III. SOVIET-AMERICAN STRATEGIC EXCHANGES

Given these two arsenals conditioned by SALT II, we can estimate the results of plausible counterforce exchanges between the U.S. and the U.S.S.R., and their residual forces can then be compared. The discussion will focus on exchanges initiated by the U.S.S.R.; this reflects the central concern of the entire exercise--assessing the impact of SALT II on U.S. deterrence capabilities.

The first task is to locate measures of post-exchange residual capabilities which reflect most accurately upon the assured destruction and essential equivalence requirements of U.S. strategic policy. One possibility is strategic throw weight--the weight of warheads and associated instrumentation carried by various delivery systems. This is a helpful measure of the potential destructive capabilities of various delivery systems in terms of the number and yield of warheads they might carry. However, given the SALT II limits on the number of RVs a missile may carry, and the number of cruise missiles an aircraft may transport, throw weight potentials can no longer be translated into enhanced actual strategic capabilities, and therefore throw weight is an inappropriate measure of residual strategic power.

The discussion on throw weight suggests that numbers of warheads is a measure of post-exchange capabilities which should be evaluated. It reflects the concerns of those who, before the SALT II limits on warheads were announced, predicted that the Soviets would translate their throw weight advantages into superiority in RVs, and it reflects the importance SALT II places on limiting warhead loadings.[12] It also bears upon the ability of the U.S. to meet its post-exchange strategic

requirements, for the number of relatively soft targets (Paul Nitze has noted that they would constitute the bulk of targets in both countries after a counterforce exchange) that can be attacked is directly related to increases in the number of separately targetable weapons.[13] Warheads, of course, vary in destructive energy, and a measure is therefore employed, equivalent megatonnage (EMT), which reflects differences in warhead yields, and which also accounts for the "wastage" of destructive energy experienced by large warheads against all but the largest targets of concern to both sides after a counterforce exchange.[14]

The next tasks of analysis are to select and to vary factors that would affect the outcomes of strategic exchanges.[15] The comprehensiveness of the selection of factors, and the realistic variation of the most salient among them, clearly determines the quality of the analysis. For example, two possible variables affecting a Soviet attack on American ICBMs are RV accuracy degradation (resulting from operational as opposed to test-firing of missiles), and strategic fratricide (the possibility that the detonation of one RV over a missile silo will degrade or destroy other RVs attacking the same silo).[16] While these factors clearly would affect current Soviet counterforce capabilities, as accuracy and system reliabilities improve, these factors will become less salient. Indeed, system improvements may render the kill probabilities of one RV almost as high as those for 2 RVs, and therefore a Soviet attack planner might become satisfied with the effectiveness of one RV, and a second RV might be targeted against a silo as a kind of insurance that at least one of the RVs would actually detonate.[17]

On the American side, two major factors affecting its capacity to respond in-kind to the Soviet attack are the ability of U.S. bombers to escape from their bases while under attack from Soviet SLBMs, and then their ability to evade Soviet air defenses and deliver their weapons on Soviet missile silos not used in the first strike.[18] So long as the Soviets do not have the tested capability to

launch SLBMs on depressed trajectories (cutting SLBM flight times to U.S. air bases), a capability they have not yet demonstrated but which is theoretically possible, most if not all U.S. B-52s and FB-111s on ground-alert might escape. However, the present analysis assumes that only 80% of the B-52s and 85% of the FB-111s (which are faster on take-offs) on alert survive the Soviet SLBM attack.[19] In terms of delivery of weapons, U.S. forces today are expected to be able to evade Soviet air defenses with relative ease, and hard targets (such as ICBM silos) are reported to be lightly defended. By 1985, however, B-52 penetrating bombers could face a combination of Soviet air-borne radar and communications (AWACs), interceptors, and Surface-to-Air Missiles (SAMs), while B-52 CMCs might have to face AWACs and interceptors. Therefore, B-52 penetrators which survive the SLBM attack are assumed to have only a 70% probability of evading Soviet air defenses and reaching their targets; 85% of the smaller and faster FB-111s are assumed to do so; and 85% of the B-52 CMCs that survived the SLBM attack are assumed to reach locations off the Soviet borders from which they release their cruise missiles.[20]

A variable which is both salient and amenable to analysis is the assumed rate of alert of the two forces before a counterforce exchange. At the extremes are exchanges which could take place between forces on routine alert, and exchanges between fully alerted forces. The first would result from a Soviet attack "out of the blue"; the second would be the climax of a Soviet-American crisis of no less than two weeks in duration. The first exchange serves as one basis for U.S. force planning; the second is one way (and perhaps the major way) U.S. officials believe an exchange might actually take place. As former Secretary of Defense Schlesinger stated, a Soviet attack, "...would most likely be preceded by a series of crises, and certainly by a sharp deterioration in our relations with the Soviet Union."[21] The Secretary noted that in these circumstances all U.S. strategic

bombers would be placed on ground alert; other officials have stated that all SSBNs not in overhaul would be sent out to sea within roughly the same period of time.[22] In addition, Soviet efforts to send their SSBNs to sea (on a routine basis only 15% of Soviet SSBNs are presently at sea; the analysis here assumes an increase to 30% by 1985, resulting from improvements in Soviet patrol capabilities), and their efforts to evacuate their cities as part of civil defense policies, would give several days warning to the United States.[23] Between these two extremes, a third possibility is explored: an exchange between day-to-day forces in which U.S. bombers are kept at a 50% alert rate rather than 30% as at present.

Holding performance characteristics of delivery systems constant, and varying the alert rates of the forces, we can then plot the results of counterforce exchanges. The Soviet Union employs their ICBMs against American ICBM silos, and their SLBMs against U.S. bomber bases and SSBN ports. The Soviets launch their ICBMs and SLBMs simultaneously, in order to minimize the warning time given to U.S. bombers. Soviet SLBMs, taking 10-15 minutes to reach U.S. bomber bases, and much less to reach submarine ports on the U.S. coast (as well as Guam and Scotland), detonate over U.S. and allied territories between 15 and 20 minutes before Soviet ICBMs reach American ICBM silo fields. The Americans therefore have 30 minutes warning that the Soviets have done <u>something</u> with their missile forces, and up to 20 minutes pass between the time Soviet missiles detonate over American territory and the time Soviet ICBMs can reach their targets--U.S. missile silos.[24] Whether the Americans could be able to react within either of these two time frames, and release their ICBMs, must be a disturbing question for Soviet strategic planners; for this discussion it is assumed that the American ICBMs are not released--the Americans decide to "ride-out" the full Soviet counterforce assault.

When the Americans do retaliate, they follow three courses of action. First,

the Americans allocate some of their surviving ICBMs against Soviet SSBN bases. Second, other surviving ICBMs (those with greater accuracy--the Minuteman IIIs) are employed against Soviet ICBMs (the exception is the case of fully alerted forces, when all surviving Minuteman IIIs are retained). Third, American bombers are sent against Soviet ICBMs not used in the initial Soviet attack; however, as with ICBMs, the Americans try to keep some bombers in reserve, in order to avoid complete reliance upon their SSBNs at sea to deter further Soviet attacks after the exchange. The Americans do not attempt to attack Soviet bombers, for these are assumed to have been widely dispersed among several Soviet air bases as soon as the Soviet first-strike began. Finally, Soviet and American submarines at sea are assumed to be invulnerable to anti-submarine warfare (ASW).

IV. ANALYSIS OF POST-EXCHANGE STRATEGIC RESIDUALS

The calculations for the exchanges are found in Appendix I; using the RV and EMT information in Tables 1 and 2, the post-counterforce exchange residuals of the two forces can be derived, and the effectiveness of the American post-exchange force can then be assessed. First consider the requirement that the U.S. maintain an absolute capability to inflict unacceptably high levels of damage upon the U.S.S.R. after a counterforce exchange. One analyst has argued that 1,047 40-kiloton RVs could threaten the 200 largest Soviet cities, placing at risk 30% of the total Soviet population and 62% of the industrial capacity of the U.S.S.R.[25] Hence one measure of U.S. absolute capabilities after an exchange is the ratio of total U.S. residual RVs to the 1,047 RV requirement.

Another measure is the ratio of total U.S. post-exchange EMT to the total amount of EMT needed to inflict unacceptable damage on the Soviet Union. A very reliable estimate is that 200 EMT could destroy <u>at least</u> 21% of the population, and 72% of the industry of the Soviet Union; 400 EMT raises the proportions

destroyed, respectively, to 30% and 76%.[26] Note, however, that neither the RV nor the EMT figures account for extensive and successful Soviet civil defense, the significance of which is still a matter of conjecture.[27] The analyst who derived the RV measure assumed an average hardness of 5 psi per structure attacked in the 200 Soviet cities; if the hardness were increased to 10 psi, representing an extremely extensive civil defense effort, then 2,512 RVs rather than 1,047 RVs would be required to threaten the 200 largest Soviet cities.[28] Also, to account for Soviet civil defense in this discussion, 400 EMT may be considered the adequate level of assured destruction capability required by the U.S. (rather, as in the 1960s, the highest level considered necessary), with damage from 200 EMT considered the absolute minimum required by the U.S. (rather than considering it the amount quite sufficient as, again, in the 1960s).[29]

The resulting U.S. assured destruction ratios are found in Table 3:

Table 3. Ratio of U.S. Residual Forces to Assured Destruction Requirements

Alert Rate (Pre-exchange)	Total RVs (Residual)	RVs/1,047	RVs/2,512	Total EMT (Residual)	EMT/200	EMT/400
Routine Alert Status	4426	4.22	1.76	785.7	3.93	1.96
Enhanced Routine Alert Status	4826(4626)	4.60(4.42)	1.93(1.84)	987.5(904.6)	4.94(4.52)	2.47(2.26)
Fully-Generated Alert Status	7943	7.58	3.16	1713.3	8.56	4.26

In what might be the worst of plausible circumstances (i.e., a Soviet attack would achieve surprise, and Soviet civil defense is considered quite effective), the United States would still have about 75% more RVs than are necessary to inflict unacceptable levels of damage on the Soviet Union. (Recall, again, that the RV

measure understates American assured destruction capabilities, for the RV ratios assume that all weapons have a 40 kiloton yield; in reality many of the U.S. residual RVs would have 100 and 200 kiloton yields.) If Soviet civil defense were ineffective, the U.S. would have at least four times the number of RVs necessary to meet its assured destruction requirements. In terms of EMT, the day-to-day American force would possess almost four times the minimum and almost two times the maximum levels needed for U.S. requirements. Finally, after an exchange between Soviet and American forces which have both been fully alerted, the United States would have between three and seven times the RVs, and between four and almost nine times the EMT needed to inflict unacceptable levels of damage on the Soviet Union should the conflict continue and escalate.

Turning to relative capabilities after a strategic exchange, these are summarized in Table 4, which indicates RVs and EMT as ratios of the total Soviet force to the total American force before an exchange, and the ratios which emerge after counterforce exchanges:

Table 4. Ratio of Soviet to American Forces Before and After Counterforce Exchanges

Alert Rate (Pre-exchange)	Measures					
	Reentry Vehicles			Equivalent Megatonnage		
	Before	After	% Change	Before	After	% Change
Day-to-Day	.82	.62	-24.4	2.01	4.24	+112
Enhanced Day-to-Day	"	.57(.56)	-30.5(-31.7)	"	3.5(2.43)	+74(+24)
Fully-Generated	"	.60	-26.7	"	1.67	-16.9

In terms of RVs, before an exchange the Soviet total force has four-fifths the number of RVs in the American total force. After an exchange involving forces

on day-to-day alert, the Soviets would have only three-fifths as many RVs, a deterioration in their relative position of about 24%. If the exchange were to take place between fully-alerted forces, the deterioration in the Soviet position would approach 27%. When measured in terms of EMT, the Soviets greatly enhance their position--by about 112%--if the exchange takes place between forces on routine alert. Between fully-alerted forces, however, a counterforce exchange would cause the Soviets to experience a 17% decline in their relative capabilities in terms of EMT.

V. ASSESSMENT AND POLICY IMPLICATIONS

Under the best of plausible circumstances, Soviet leaders could not expect a first-strike against U.S. forces to render the Americans unable both to respond in-kind and be able afterwards to inflict unacceptable damage on the U.S.S.R. if the conflict were to continue and escalate. Hence the first requirement of U.S. strategic policy can be met in the context of SALT II. Second, while the U.S.S.R. could possibly expect to achieve a substantial improvement in its relative position in terms of EMT after an attack on U.S. day-to-day forces, if the exchange takes place after the U.S. receives modest warning, then the U.S.S.R. would experience a deterioration in its capabilities as measured in relative EMT. Regardless of the circumstances, the Soviets can only expect a counterforce exchange to result in a decline in their relative strategic power in terms of residual reentry vehicles. Therefore, while the margin of safety is not as high as in the case of meeting assured destruction requirements, the United States in a SALT II context can be confident that it would continue to meet the requirements for post-exchange essential equivalence in RVs under all circumstances, and in EMT under likely circumstances.

On the other hand, as can be noted in Appendix I, an exchange between Soviet

and American forces on routine alert would result in one major asymmetry: the Soviets would have a much more diverse arsenal in terms of delivery systems. After all exchanges the Soviets would have a very balanced mix of ICBMs, SLBMs, and bombers. In contrast, the day-to-day U.S. residual force could be comprised of only 22 ICBMs and 7 bombers--the vast majority of U.S. residual capabilities would reside in its submarines. This lack of diversity is remedied if the exchange takes place between fully-alerted forces: in this case the Soviet force remains balanced, and the American arsenal would have 57 ICBMs, a vast SSBN force, and quite importantly, 96 bombers.

Nevertheless, in light of the Soviet gain in relative EMT if the projected U.S. day-to-day force is attacked, and given the lack of diversity in the U.S. arsenal which would result, an American decision in favor of SALT II might best be taken in conjunction with an increase in the routine alert rate for U.S. bombers from 30% as at present to a higher rate--perhaps 50%, as in the 1960s. With an enhanced bomber alert rate the U.S. could respond in two general ways to a Soviet first-strike. If diversity is considered essential, the enhanced bomber alert rate would leave the United States with 35 (rather than 7) bombers after a counterforce exchange, and 23 of these would be Cruise Missile Carriers. Even with this more diverse force the Soviet advance in relative EMT would be cut from 112% to 74%. If cutting deeply into the Soviet relative EMT advantage is considered more important, the U.S. could allocate more bombers to its counterforce response. In this situation, an enhanced bomber alert allows the U.S. to cut the advance in EMT the Soviets could expect via a first-strike from 112% to 24%. Even with the allocation of more bombers to a counterforce response, a residual American arsenal with the enhanced bomber alert rate is more diverse than an arsenal with a 30% bomber alert rate; after a counterforce exchange, the former would still have 23 bombers, rather than 7 bombers as would be the residual for the latter. Hence,

over the life of the Treaty, or until the U.S. is able to deploy partially-mobile ICBMs or large numbers of modified commercial aircraft equipped with cruise missiles (the latter would allow B-52 CMCs to be reconverted into penetrating bombers), an enhanced bomber alert rate would make a substantial contribution to U.S. strategic policy.[30]

In conclusion, under likely circumstances the United States will be able to meet its strategic requirements in a SALT II context, and with relatively minor alterations in its operations, under virtually all plausible circumstances the United States will meet the requirements for a successful strategic policy. That is, the American arsenal will be of such power during this period that the Soviet Union could not expect to gain militarily or politically through the use or the threat of use of nuclear weapons. Based on this analysis, there is no "open door" opened by SALT II to Soviet adventurism.

Of course, as noted in the introduction, this assessment is made on the basis of assumptions formulated in a context of great uncertainty. There are some actions that could be taken by the Soviet Union that could affect the strategic balance dramatically. One in particular should be noted: if the Soviets were to develop and to test submarine-launched missiles fired on depressed trajectories, then their theoretical flight-time to American air bases would be reduced to a very great degree; the bombers would then have much less time to scramble after the initiation of a Soviet attack. The result of depressed-trajectory SLBMs would probably be a significant deterioration in American air-based counterforce and residual capabilities. This problem of depressed-trajectory SLBMs places important responsibilities on American monitoring capabilities, and should be one focus of American attention in SALT III.

Assuming, however, that over the life of the treaty the Soviets do not deploy new and particularly destabilizing capabilities, and assuming that the Soviets

comply with the provisions of the treaty, then one may be quite confident that the strategic balance under SALT II simply will not so favor the Soviets that they will engage in adventurism. Of course, the treaty by itself will not cause strategic stability; that, in fact, is the result of the treaty and the level, quality, and diversity of American forces which have been or are about to be deployed. However, the treaty does impose real constraints on Soviet strategic programs, especially in terms of imposing trade-offs between placing MIRVs in ICBMs and SLBMs, and in terms of limiting their ability to translate strategic throw weight into additional numbers of warheads. (Indeed, the true importance of this limit on warheads will be felt not during the period covered by SALT II but later, when it will prevent the Soviets from matching the increases in American first-strike targets resulting from the MX basing-mode--but that is another story.) In sum, from a strictly military point of view, SALT II will not detract from, and it may contribute modestly to American national security, and should therefore be ratified by the United States Senate.

Appendix I

Case 1. Both Forces on Day-to-Day Alert

The Soviet Attack

The Soviets attack 1004 U.S. ICBMs with 2 SS-18 RVs per target, or a total of 201 SS-18s. Against each of 34 U.S. air bases and 5 SSBN bases, the Soviets employ 6 RVs from SS-NX-17 SLBMs, which, with a system reliability of 85%, ensures 5 detonations over each target. The United States has 55% of its Poseidon SSBNs and 66% of its Trident SSBNs at sea, while the Soviets have 30% of their SSBNs on patrol.[31] As has been mentioned, 30% of the U.S. bombers are on alert.

Damage expectancies for the SS-18 are as follows:[32]

Yield: .75 Megatons
Accuracy (CEP): 0.1 nautical miles
System Reliability: 85
Target Hardness: 2000 psi
SSKP[33]: .86
Damage Expectancy (1 RV): .73
Damage Expectance (2 RVs): .93

The Soviet attack is as follows:

Allocate	108 RVs	900 RVs	400 RVs	600 RVs	234 RVs
Attack	54 Titan II	450 MMII	200 MMIII	300 MMIII	39 air and sub bases
Kill	51	419	186	279	39
Survivors	3	31	14	21	0

Soviet Forces used in attack: 201 SS-18s, 78 SS-NX-17s.

The American Response

The U.S. keeps SSBNs at sea in reserve. It does not attmept to attack Soviet bombers--they are too dispersed. All surviving Titan IIs and 9 MMIIs are allocated against two Soviet SSBN bases.[34] All MMIIIs are targeted against SS-18s not used in the Soviet first-strike. After keeping in reserve 7 B-52Hs, all other bombers are used against Soviet ICBM silos. U.S. bomber availability is as follows:

Type	On Alert	Survive SLBM Attack	Survive Air Defense	Total Hard Target Weapons
B-52 CMC	36	29	25	500
B-52G	9	7	5	20
B-52H	18	14	10	40
FB-111	18	15	13	26
B-52HRes	9	7	.....	

Damage expectancies for U.S. hard target weapons are as follows:

Type	Yield (MT)	CEP (NM)	Rel.	Target	SSKP	DE (1 RV)
MMIII MK12	.17	.1	.85	2000 psi	.53	.45
MMIII MK12A	.35	.1	"	"	.72	.61
Cruise Missile	.20	.05	"	"	.95	.80
Gravity Bomb	1.0	.05	"	"	.99	.84

The American counterattack is in two waves:

A. MMIII Attack

Allocate	63 MK12A RVs		42 MK12 RVs		
Attack	63 SS-18		42 SS-18		
Kill	38		19		
Survivors	25	+	23	+ 2 not attacked	= 50 SS-18s

B. Bomber Attack

Allocate	50 bombs	36 bombs	329 CMs	135 CMs	34 CMs
Attack	50 SS-18	36 SS-19	329 SS-19	135 SS-17	34 SS-11 FO
Kill	42	30	263	108	27
Survive	8	6	66	27	7

Residuals

The Soviet Union

Type	Number	Total RVs	Total EMT
SS-18	8		
SS-19	72	815	1951.3
SS-17	27		
SS-11 FO	195		
SS-NX-17	130		
SS-NX-18	80	1302	359.4
Typhoon	48		
Bear	100		
Bison	40	640	1024.0
Backfire	250		
Totals	950	2757	3334.7

The United States

Type	Number	Total RVs	Total EMT
MMII	22	22	22
C-3	160	4288	702.4
C-4	256		
B-52H	7	116	61.4
Totals	445	4426	785.8

Case 2. Enhanced American Day-to-Day Alert

The Soviet first-strike against American forces is as in Case 1; however, 50% rather than 30% of the U.S. bombers are on alert. In Case 1, all but 7 B-52Hs were allocated to the American counterforce response; in Case 2, either 23 or 11 B-52 CMCs are held in reserve, as are 12 B-52Hs. The attack on Soviet SSBN ports is as in Case 1, as is the Minuteman attack on SS-18s. The attack follows:

Allocate	50 bombs	94 bombs	271 CMs	135 CMs	14 CMs or	214 CMs
Attack	50 SS-18	94 SS-19	271 SS-19	135 SS-17	14 SS-11 FO	214 SS-11 FO
Kill	42	79	217	108	11	171
Survivors	8	15	54	27	3 (+ 208 = 211)	43 (+ 8 = 51)

Residuals

The Soviet Union

Type	Number	Total RVs	Total EMT
SS-18	8		
SS-19	69	813 (653)	2053.7 (874.5)
SS-17	27		
SS-11 FO	211 (51)		
SS-NX-17, SS-NX-18	258	1302	359.4
Bear, Bison, Backfire	390	640	1024.0
Totals	963 (803)	2755 (2595)	3437.1 (2257.9)

The United States

Type	Number	Total RVs	Total EMT
MMII	22	22	22.0
C-3, C-4	416	4288	702.3
B-52 CMC	23 (11)	460 (220)	157.9 (75.02)
B-52H	12	216	105.3
Totals	473 (461)	4986 (4746)	989.5 (904.6)

Case 3. Both Forces on Full Alert

A crisis of no less than 16 days in duration precedes this exchange. Both sides have sufficient warning to place all combat-ready aircraft on alert, and to place all SSBNs not in overhaul out to sea. About one-third of all Soviet SSBNs except its Typhoons are estimated to be in overhaul and cannot be dispersed, while an estimated 20% of U.S. Poseidons are in overhaul and also cannot be sent to sea. All Typhoons and Tridents can be sent to sea, for none have been in service the time period requiring an overhaul.[35]

The Soviet attack is similar to earlier cases. The American response is different in that all surviving MMIIIs are retained for there are sufficient bomber forces available to attack all Soviet silos. Indeed, after allowing for attrition, the U.S. is able to retain a sizable B-52 CMC and B-52H force. The employment of Titan IIs and MMIIs against Soviet SSBN bases is similar to the earlier cases. The attack follows:

Allocate	107 bombs	183 bombs	182 CMs	135 CMs	222 CMs
Attack	107 SS-18	183 SS-19	182 SS-19	135 SS-17	222 SS-11 FO
Kill	90	154	146	108	178
Survivors	17	29	36	27	44

Residuals

The Soviet Union

Type	Number	Total RVs	Total EMT
SS-18	17		
SS-19	65	712	876.6
SS-17	27		
SS-11 FO	44		
SS-NX-17	386		
SS-NX-18	208	3462	968.8
Typhoon	120		
Bear			
Bison	390	640	1024.0
Backfire			
Totals	1257	4814	2869.4

The United States

Type	Number	Total RVs	Total EMT
MMII	22	127	66.2
MMIII MK12	14		
MMIII MK12A	21		
C-3	224	6144	1013.7
C-4	376		
B-52 CMC	62	1672	633.4
B-52H	24		
Totals	743	7943	1713.3

Footnotes

1. As an example of the view that the Soviets might seek to exploit temporary military advantages, see Henry Kissinger comments in an interview published in the Economist: "Kissinger's Critique," Part I, The Economist (February 3, 1979), p. 20.

2. On the possibility of this development see Committee on the Present Danger, Is America Becoming Number 2? Current Trends in the U.S.-Soviet Military Balance (Washington: 1978), p. 2, and the Committee on the Present Danger, "Does the Official Case for the SALT II Treaty Hold Up Under Analysis?," (Washington: March 1979), pp. 19-20. Kissinger alludes to the problem in the interview cited above, pp. 18-19.

3. For a recent statement of American policy employing these concepts, see U.S., Congress, Senate, Committee on Armed Services, Department of Defense Authorization for Appropriations for Fiscal Year 1979, Pt. 1 (1978), p. 65. (Hereafter all hearings on appropriations before this Committee will be referred to as Senate DOD Hearings, the appropriation fiscal year and Part (Pt.), and page number.)

4. For the text of the treaty, see Department of State Bulletin, Vol. 79, No. 2028 (July 1979), pp. 23-48; see also Annual Report of the Secretary of Defense for Fiscal Year 1980 (hereafter referred to as DOD FY 1980 Report), (25 January 1979), pp. 38-39.

5. The new Soviet ICBM is reported in Clarence A. Robinson, "SALT Stance Allows New Missile," Aviation Week and Space Technology (hereafter this journal is cited as AWST), (24 April 1978), p. 16.

6. Roll-out of a new Soviet bomber is anticipated in DOD FY 1980 Report, p. 73, and Clarence A. Robinson, "Soviets Developing Two Bombers, Extending Range of Backfire," AWST, (19 February 1979), pp. 14-15.

7. Secretary of Defense Harold Brown indicated that seven or eight years would be required to deploy the MX--this statement was made in February 1978; see Senate DOD Hearings, FY 1979, Pt. 1, p. 540. The Trident II, which might be used in a land-based mode as well as in Trident SSBNs, will not be available until the late 1980s; see Senate DOD Hearings, FY 1979, Pt. 2, p. 1037.

8. The alternative would be to retire Yankee or Delta I SSBNs prematurely; the former entered service in 1968, and the latter began patrols only in 1973. See Senate DOD Hearings, FY 1979, Pt. 1, p. 423.

9. The figure of 10 Trident SSBNs is taken from a chart in Senate DOD Hearings, FY 1979, Pt. 1, p. 120.

10. Originally only 10 Poseidon SSBNs were to be retrofitted with C-4s; for the figure of 12, see Senate DOD Hearings, FY 1979, Pt. 1, p. 121.

11. The Committee on the Present Danger, for example, uses a figure of 10; see Is America Becoming Number 2?, p. 6.

12. As an example of this concern about throw weight and RVs, consider the following: "Since no limits are placed on the numbers of warheads that can be placed on a delivery vehicle in either the tentative agreement or in Vladivostock, the Soviet Union, with its superior throw weight capability, can achieve superiority in warheads within a few years," Clarence A. Robinson, "SALT Agreements Face Trouble in Congress," AWST, (17 October 1977), p. 16.

13. Alain C. Enthoven and K. Wayne Smith discuss the relationship between weapons available and targets attacked in How Much Is Enough: Shaping the Defense Program, 1961-1969, (New York: Harper and Row, 1971), p. 182-183. On the preponderance of soft targets after a counterforce exchange, see Paul H. Nitze, "Assuring Strategic Stability in an Era of Detente," Foreign Affairs, Vol. 54, No. 2, (January 1976); note that Nitze believes that throw weight is the preferable measure of post-exchange residual capabilities.

14. On the concept of "wastage" see Albert Wohlstetter, "Is There a Strategic Arms Race: Part II," Foreign Policy, No. 16 (Fall 1976), p. 58; also see Thomas J. Downey, "How to Avoid Monad--and Disaster," Foreign Policy, No. 24 (Fall 1976), p. 175; and Robert Sherman, "A Manual of Missile Capability," Air Force Magazine, (February 1977), p. 36.

15. On the construction of models of strategic exchanges, see Downey, and Sherman, (fn. 14); also see Lynn Etheridge Davis and Warren R. Schilling, "All You Ever Wanted to Know About MIRV and ICBM Calculations But Were Not Cleared to Ask," Journal of Conflict Resolution, XVIII (June 1973), especially p. 217; for an official discussion, see Senate DOD Hearings, FY 1978, Pt. 10, p. 6847.

16. On accuracy degradation see the testimony of then Secretary of Defense James Schlesinger in U.S., Congress, Senate, Committee of Foreign Relations, Subcommittee on Arms Control, International Law, and International Organization, U.S.-U.S.S.R. Strategic Policies, (March 1974), p. 15. On degradation and fratricide, see Joseph J. McGlinchey and Jacob W. Seelig, "Why ICBMs Can Survive a Nuclear Attack," Air Force Magazine, (September 1974), pp. 80-84.

17. The concept of a second RV as insurance is discussed in U.S., Congress, Congressional Budget Office, Background Paper: Counterforce Issues for U.S. Strategic Nuclear Forces, (Washington, D.C.: January 1978), p. 12. (Hereafter the paper is cited as CBO Paper.)

18. The employment of U.S. bombers against Soviet ICBMs is discussed in Senate DOD Hearings, FY 1979, Pt. 10, p. 6079, and DOD FY 1980 Report, p. 71. Paul Nitze uses bombers in his model of a strategic exchange; see his Letter to the Editor, Foreign Affairs, Vol. 54, No. 4, (July 1976), p. 821.

19. On the current expectation that most bombers on alert would survive, see CBO Paper, p. 23. The problem of depressed trajectory attacks by SLBMs is discussed in Senate DOD Hearings, FY 1976 and 7T, p. 5522.

20. High bomber penetration capabilities are noted in Senate DOD Hearings, FY 1979, Pt. 2, p. 1108; the assessment is made by Under Secretary of Defense for Research and Development William Perry. The assessment of relatively light defense of Soviet hard targets is attributed to U.S. Air Force officers; see "Three Programs

Key in Strategic Effort," AWST, (29 January 1979), p. 139. The capability of the U.S.S.R. to develop effective AWACs and interceptors with a look-down, shoot-down capability is discussed in Senate DOD Hearings, FY 1976 and 7T, Pt. 10, p. 5522, and Senate DOD Hearings, FY 1978, Pt. 9, p. 6065, 6067. Of course, a comprehensive air defense composed of AWACs, interceptors, and radar-guided SAM-los would be extremely expensive, costing perhaps $30 or $40 billion; see "Cruise Missile Called Costly to Counter," AWST, (12 June 1978), p. 20.

21. Senate DOD Hearings, FY 1976 and 7T, p. 63.

22. The figure of 16 days is based on the time necessary to refit a Poseidon SSBN in a crisis situation; it was given by Rear Admiral Albert L. Kelln, USN, Director of the Strategic Submarines Division and Trident Program; he noted that Tridents could be refitted in 12 days. See Senate DOD Hearings, FY 1978, Pt. 10, p. 6624.

23. The U.S. Navy's Director of Naval Intelligence, Rear Admiral Donald P. Harvey, reported that the U.S. could observe increases in the exits of Soviet SSBNs from their ports; see Senate DOD Hearings, FY 1978, Pt. 10, p. 6665. He noted as well that the Soviets have never attempted to more their SSBNs out to sea in a crisis mode; see ibid., p. 6626. Secretary Brown has reported that the Soviets would need at least a week to evacuate their major cities; see DOD FY 1980 Report, p. 69.

24. I am indebted to Mr. John Mearsheimer for bringing these two time-frames to my attention.

25. Geoffrey Kemp, Nuclear Forces for Medium Powers, Parts II and III: Strategic Requirements and Options, Adelphi Paper No. 107, (London: IISS, 1974), p. 26.

26. Enthoven and Smith, (fn. 13), p. 207.

27. For contrasting views on Soviet civil defense, see U.S., Congress, Joint Committee on Defense Production, Defense Industrial Base: Industrial Preparedness and Nuclear War Survival, Pt. I, Appendix II, Industrial Recovery and Survival After Nuclear Attack, (a report prepared by the Boeing Aerospace Company), (November 1976), pp. 55-133; and U.S., Congress, Senate, Committee on Banking, Housing and Urban Affairs, Civil Defense, Appendix I, "An Analysis of Civil Defense in Nuclear War," (a report prepared by the U.S. Arms Control and Disarmament Agency), (January 1979), pp. 93-116. For an assessment of the entire issue, see Fred M. Kaplan, "Soviet Civil Defense: Some Myths in the Western Debate," Survival, XX, (May-June 1978), pp. 113-120.

28. Kemp, (fn. 25), p. 26.

29. Enthoven and Smith, (fn. 13), pp. 207-208.

30. When Secretary of Defense Schlesinger announced in 1975 that the U.S. bomber alert rate would be reduced from 40% to 30%, he reported that by FY 1979 the savings in manpower costs--the alert rate within this band of levels is a function of the number of crews available per bomber and tanker--would be about $272 million per year; see Senate DOD Hearings, FY 1976 and 7T, Pt. 1, p. 64. Assuming then that both increments of 10% would cost the same, the total additional cost of having a 50% alert rate would be $574 million. Assuming an inflation rate of 8%

per year, the total additional cost over the life of the Treaty (1980-1985) would be about $4.4 billion. If commercial aircraft were adapted for strategic use and equipped with cruise missiles, B-52 CMCs could be reconverted into penetrating bombers, and with the larger overall bomber force, the alert rate could safely be reduced.

31. The number of U.S. bomber bases is derived from the "Guide to USAF Bases at Home and Abroad," Air Force Magazine, Almanac Issue, (May 1979), pp. 151-159. Submarine bases are listed in Senate DOD Hearings, FY 1979, Pt. 10, p. 6618. American SSBN alert rates are in Senate DOD Hearings, FY 1979, Pt. 2, p. 1031-1032; the current Soviet SSBN at-sea rate is given in ibid., Pt. 1, p. 424; and reasons to expect an increase in this rate are noted in DOD FY 1980 Report, p. 73.

32. SS-18 yield, accuracy, and reliability are from Peter Hughes, "SALT II and the Emerging Strategic Threat," Air Force Magazine, (March 1979), p. 49.

33. Using yield, accuracy, and target hardness values, the Single Shot Kill Probability (SSKP) is derived using the Rand Damage Probability Calculator. See D. C. Kephart, Damage Probability Computer for Point Targets with P and Q Vulnerability Numbers, R-1380-PR, (Santa Monica: February 1974).

34. One publicly identified Soviet SSBN base is at Petropavlovsk, on the Kamchatka Peninsula; a second is reportedly on or near the Barents Sea, possibly at Archangel, Murmansk, or Petrozavodsk. See Norman Polmar, "The Soviet SLBM Force," Air Force Magazine, (March 1978), p. 45; and Richard T. Ackley, "The Wartime Role of Soviet SSBNs," United States Naval Institute Proceedings, (June 1978), p. 40.

35. The current Poseidon force entered service during the five year period, 1963-1967 (Senate DOD Hearings, FY 1979, Pt. 1, p. 119), and each SSBN requires an overhaul every 6 years (Senate DOD Hearings, FY 1978, Pt. 10, p. 6621). Assuming the SSBNs were deployed at a rate of 6 per year, then in 1985 the 6 Poseidons launched in 1967 would be in overhaul and could not be sent to sea in a crisis. All Trident SSBNs could be dispersed to sea, since none will have been in service the time period (9 years) after which an overhaul is necessary. The Soviets overhaul about 20 SSBNs per year (Senate DOD Hearings, FY 1979, Pt. 1, p. 424), or about one-third of their force; these too could not be put to sea rapidly. As in the case of Tridents, Typhoon SSBNs will be in service so short a period of time by 1985 that none of them would probably be in overhaul.

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(Numbers 1-3 and 6 are no longer available.)

4. Arthur Stein. **Strategic Doctrine for a Post-SALT World.** March 1974.

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7. Pauli Jarvenpaa. **Flexible Nuclear Options: New Myths and Old Realities.** September 1976.

8. Walter J. Petersen. **A Research Note on Strategy in Coalition Gaming.** November 1976.

9. Joseph M. Grieco. **Paul H. Nitze and Strategic Stability: A Critical Analysis.** November 1976.

10. Samuel L. Hall. **Weapons Choices and Advanced Technology: The RPV.** September 1978.

11. Jon S. Eckert. **Trends in U.S. Air Force Tactical Fighter Life Cycles.** April 1979.

12. Joseph M. Grieco. **A Military Assessment of SALT II.** September 1979.

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Guernica (1937) by Pablo Picasso
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